

MULTIPLE ECTOPIC LIMBS IN A WILD POPULATION OF *HYLA REGILLA*

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ABSTRACT.— A wild population of Pacific tree frogs (*Hyla regilla*) in Idaho exhibited a high incidence (22%) of hind limb abnormalities. This situation is discussed with reference to similar occurrences reported for isolated populations of the species in the Pacific Northwest.

Isolated cases of amphibians found in nature with extra legs (polymelia) are not uncommon (Van Valen 1974). Occurrences of significant numbers of such defects among small populations of amphibians, however, are less common and of much greater importance. Reports of polymelic populations (Van Valen 1974) have occurred fairly regularly since 1948 and have included *Hyla regilla*, *Ceptodactylus* sp., *Rana catesbeiana* (two separate populations), *Rana esculenta ridibunda*, and "frogs." These reports have come from a wide geographical range including Russia, Ecuador, and several sites in the United States (Montana, New Jersey, Ohio, and Mississippi).

One report not included in the Van Valen (1974) review concerns a second population of polymelic *Hyla regilla* in a small pond in Spokane, Washington (Miller 1968). We will expand upon the report of polymelia in *Hyla regilla* that was included in the Van Valen review (1974). In August 1958 (the same year as polymelic *Rana catesbeiana* were discovered in Mississippi, Volpe 1981:3–4) several polymelic *Hyla regilla* were taken from a pond near Polson, Montana (14 malformed of a total population of 73 examined; Hebard and Brunson 1962). The next year four more malformed specimens were taken from the same Montana pond (of a total of 13 examined), and in 1960 and 1961 similar proportions of polymelia were observed there. The report of the Spokane population (Miller 1968) was very brief and had few details. That population was sampled only once.

The purpose of the present paper is to report a third population of polymelic *Hyla regilla* found in the fall of 1981 in Boise, Idaho. We will discuss the striking regionality of this defect and its implications concerning etiology.

STUDY AREA

Our specimens were collected from a small (approximately 0.2 ha) pond located in a low-lying area within a housing complex on the southwest side of Boise, Ada County, Idaho (SW ¼ SW ¼ Sec. 2, T2N, R1E Boise Meridian; Universal Transverse Mercator Coordinates 482000 N, 555650 E, Zone 11). Maximum water depth was 0.5 m. Cattail (*Typha latifolia* L.) was the dominant vegetation of the pond environs. There was no obvious water inlet or outlet for the pond. The Paris lateral canal, part of the local irrigation network, passed within 10 m of the north side of the pond. Presumably, underground seepage from the canal was the source of pond water. A local resident stated that the pond was often dry or nearly so in the early spring, but would increase in size by late summer to nearly one acre (0.4 ha). For mosquito control purposes, the Ada County Mosquito Abatement District applied Bx-2 coated granules to the pond at a dosage rate of 5 pounds per acre on 26 May, 16 and 31 June, and 31 July 1981 (R. Shore, pers. comm.). Bx-2 granules contain 2% (by weight) of the larvicide Baytex (FMC Corporation). This compound has no known teratological effects, but

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is reported to be toxic to a variety of invertebrate and vertebrate classes.

METHODS

Abnormal frogs in the pond were noticed by a local resident and reported to the pesticide inspector of the Idaho Department of Agriculture ca 5 September 1981. One of us (TDR) was contacted and collecting trips were made to the pond on 10, 16, and 23 September and 3 October 1981. Using long-handled aquatic insect nets, efforts were made to capture all frogs observed. The majority of the frogs captured were transported to the biology departments of Boise State and Idaho State universities and placed in aquaria for future breeding and teratological experiments. Some normal individuals were returned to the pond after close inspection revealed no limb anomalies.

RESULTS

A total of 54 Pacific tree frogs (*Hyla regilla*) were captured. Thirteen (22%) exhibited hind limb abnormalities. No fore limb anomalies were noted. The defects ranged from a small midcaudal bleb or polydactyly of one foot to complete and multiple hind limb polymelia with concomitant polydactyly (Table 1; Figs. 1 and 2). Abnormalities occurred in equal numbers on the left and right sides of the animals. The degree

TABLE 1. Occurrence, sidedness, and severity of hind limb abnormalities in a wild population of *Hyla regilla* from Boise, Ada County, Idaho, 1981.

Hind limb morphology	Number of individuals affected			
NORMAL	41			
	Left side	Mid-line	Right side	Total
ABNORMAL				
Midcaudal blebs	0	2	0	2
Clinodactyla	1	0	0	1
Polydactyla	2	0	1	3
Partial polymelia	2	0	0	2
Partial polymelia and polydactyla	0	0	1	1
Complete polymelia and polydactyla	0	1	1	2
Multiple complete polymelia and polydactyla	0	0	2	2
Totals	5	3	5	13

of function of the polymelic limbs was variable, and ranged from no discernible function in some ectopic limbs to nearly normal function in others.

DISCUSSION

Although the sample size in this study was small, the results indicate a high incidence (22%) polymelia and polydactyly in a wild hylid population. The polymelia observed in this study involved only the hind limbs. This is consistent with Van Valen's (1974) statement that the fore limbs are rarely affected in polymelic populations. This Idaho population of hylids exhibited the same types of defects as the polymelic hylids found in Montana and Washington. This is consistent with Van Valen's (1974) observation that "specific kinds of abnormalities are different for each species or subspecies (but not between populations within species)."

All three reported cases of polymelic populations of *Hyla* have occurred in the intermountain regions of the Northwest United States (i.e., Montana, Washington, and Idaho). If polymelia was ubiquitous to the entire population of *Hyla regilla*, it would be



Fig. 1. Live *Hyla regilla* taken from the north edge of the Boise pond, 3 October 1981. The ectopic leg represents a duplication of the entire leg distal to the knee.

much more likely for such malformations to be noted in the Pacific coast populations, where both frogs and observers are more common, than in the more remote reaches of the hylid range. Indeed, the three abnormal populations were confined to isolated pockets of *Hyla regilla* located well outside the main geographic distribution of the species (Fig. 3).

It is conceivable that these three populations of *Hyla* represent only marginally successful isolates and that whatever environmental factors restrict the existence of *Hyla* in adjacent, nonpopulated areas contribute to the malformations in the isolates. A large

number of environmental factors could be postulated. The most obvious restricting factor in that general region of the United States is climate. The three sites where the hylid populations exist are areas of comparatively greater rainfall and more moderate temperatures than the general, more hostile environment of that region.

Van Valen (1974) discussed possible etiologies in his review of polymelia. They included genetic defects, viruses, parasites, radiation, pH, temperature, and desiccation. Of that list, the last two are the most interesting in relation to the isolated *Hyla* populations being discussed. The pond in Boise is reported as being dry for a large portion of the year. One of us (TDS) visited the pond in May 1982 and found the pond completely dry. It is thus possible that the *Hyla* of that pond are breeding later than normal or that the eggs are laid in rather dry conditions. Voitkevich (1958, 1961) noted that the polymelous *Rana esculenta ridibunda* that he observed in one reservoir were found mostly in the region of cold spring water. He suggested that cold-related developmental retardation may result in such malformations. Lastly, Miller (1968) noted that the pond where the



Fig. 2. Fixed *Hyla regilla* taken from the north edge of the Boise pond, 3 October 1981. The frog exhibits four complete legs joined at the pelvic girdle. It is difficult to determine which legs are "normal" and which are "abnormal."



Fig. 3. Outline map of the western United States, with the distribution of *Hyla regilla* indicated by diagonal lines. High concentration areas are marked by cross-hatching. The locations of the three polymelic *Hyla* populations are indicated by the circles (After Jameson et al. 1966; Fig. 13).

Washington *Hyla* were collected had been sprayed for mosquitoes. The Idaho pond had also been sprayed for mosquitoes. Nevertheless, such observations cannot be considered as anything more than coincident at this point.

We hope to follow up on all three Northwestern *Hyla* populations in the future in an attempt to gather more information about possible etiology.

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